

**Field Sampling Plan (FSP)
For
Remedial Investigation
Dallas Housing Authority
Operable Unit 02
January 1994**

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1

Section
One

Section 1

Sampling Objectives

The RI Field Sampling Plan will incorporate field activities and data analyses to characterize the nature and extent of contamination at the DHA site for purposes of assessing risk associated with the contaminants of concern and evaluating remedial alternatives to address that risk. Through the course of the field investigation, a database will be developed which characterizes the following site media:

- Surface Soils,
- Subsurface Soils,
- Groundwater,
- Sediments, and
- Surface Water.

In order to fully characterize these media, CDM will re-analyze selected archived samples from the 1991/1992 investigation for arsenic, cadmium and EPA's Target Analyte List.

In order to address the potential contamination in the Kingbridge Park area, it is proposed to first conduct a geophysical survey to locate the subsurface anomalies and, second employ intrusive techniques to sample subsurface soils and groundwater.

CDM will also collect surface water and sediment samples to characterize both media and determine if they have been impacted by surface and subsurface contamination at the site.

The remainder of this report details the location and frequency of sampling as well as the methodologies by which the samples will be collected. Also included is a summary of all prescribed analyses.

2

Section
Two

All surface water and sediment samples will be analyzed for TAL metals. Surface water will be analyzed for total and dissolved metals. Total suspended solids (TSS) will be an additional parameter for surface water. TSS, coupled with contaminant concentrations on sediments will be used to evaluate risk and exposure scenarios related to consumption of surface water. Three sediment samples and three surface water samples will also be analyzed for TCL constituents. Samples for TCL/TAL will be selected from the areas most likely to contain contamination and will be based on field observations.

Section 2

Sampling Location and Frequency

Method Description to Define Extent of Contamination

The Remedial Investigation will incorporate field activities and data analyses to characterize the nature and extent of contamination at the DHA Site for the purposes of developing and evaluating remedial alternatives, and assessing the risk of existing or threatened contaminant migration on human health and the environment. Through the course of the field investigation, a database will be developed to use in characterizing all media at the site, contaminant fate and transport processes, and contaminant impacts on public health and the environment. This section lists the objectives of each portion of the field sampling plan.

The sampling program developed for this RI/FS will address the following media:

- Analyses on archived surface and subsurface samples;
- Near-surface geophysical surveys;
- Subsurface soil sampling;
- Groundwater sampling;
- Sediment sampling; and
- Surface water sampling.

Table 2-1 provides a summary of the media to be sampled during the field exercises. Field QA/QC samples are not included on the table. A brief summary of laboratory analyses is included in each subsection. Section 3.5 details the prescribed laboratory analyses for all samples to be collected at the DHA Site.

Archived Samples

The purpose of re-analyzing archived samples is to enhance the previously collected arsenic and cadmium data generated by XRF analyses. Select archived samples will also be analyzed for the Target Analyte List (TAL) metals as a means of determining whether other potential contaminants of concern are present on-site above a depth of 18 inches below ground surface.

Ninety-three of the original grid sampling locations will be re-analyzed for arsenic and cadmium as part of this effort. Each of the five samples from each sampling point will be re-analyzed. All of the sampling locations within the 99% Confidence Interval (CI) and all of the odd numbered locations outside of

Table 2-1
Summary of Sampling Locations by Media
Dallas Housing Authority Site

Monitoring		Media to be Sampled (Sample ID)			
Point		*Soil		Sediments	**Groundwater
		Surface	Subsurface		Surface Water
Archived Samples		726			
RI-MW-	1				2
RI-MW-	2				2
RI-MW-	3				2
RI-MW-	4				2
RI-MW-	5	1	2		2
RI-MW-	6	1	2		2
RI-MW-	7	1	2		2
RI-MW-	8	1	2		2
RI-BH-	1	1	2		
RI-BH-	2	1	2		
RI-BH-	3	1	2		
RI-BH-	4	1	2		
RI-BH-	5	1	2		
RI-BH-	6	1	2		
RI-BH-	7	1	2		
RI-BH-	8	1	2		
RI-SD-	1			2	
RI-SD-	2			2	
RI-SD-	3			2	
RI-SD-	4			2	
RI-SD-	5			2	
RI-SD-	6			2	
RI-SD-	7			2	
RI-SW-	1				2
RI-SW-	2				2
RI-SW-	3				2
RI-SW-	4				2
RI-SW-	5				2
RI-SW-	6				2
RI-SW-	7				2
Total		738	24	14	16

*Surface samples include the zero to eighteen inch depth interval.

**Filtered and unfiltered samples (shown here as separate samples) will be collected from each well and each surface water sampling location and analyzed.

the CI were selected (see Figure 2-1). Locations selected for TAL analyses are shown in Figure 2-2. These 76 locations represent approximately every third location across the site. The 0-1 inch sample interval from each of the 76 locations will be analyzed. This represents approximately 9% of the initial 830 samples collected. The complete analytical summary is provided in Section 5 of this plan.

Surface Geophysical Surveys

During the RI activities, CDM proposes to conduct a geophysical survey to delineate suspected landfill areas identified in historical aerial photos and reports. Geophysical techniques are an efficient and economical method to delineate subsurface anomalies prior to intrusive activities. CDM proposes the use of the Geonics EM-31 to perform an electromagnetic survey of the area shown in Figure 2-3. The EM-31 measures subsurface electrical conductivity variations that are a result of shallow subsurface soil density variations as well as variations in the conductivity of the groundwater. Localized Groundwater conductivity variations within a discrete water bearing zone is an indication of groundwater contamination.

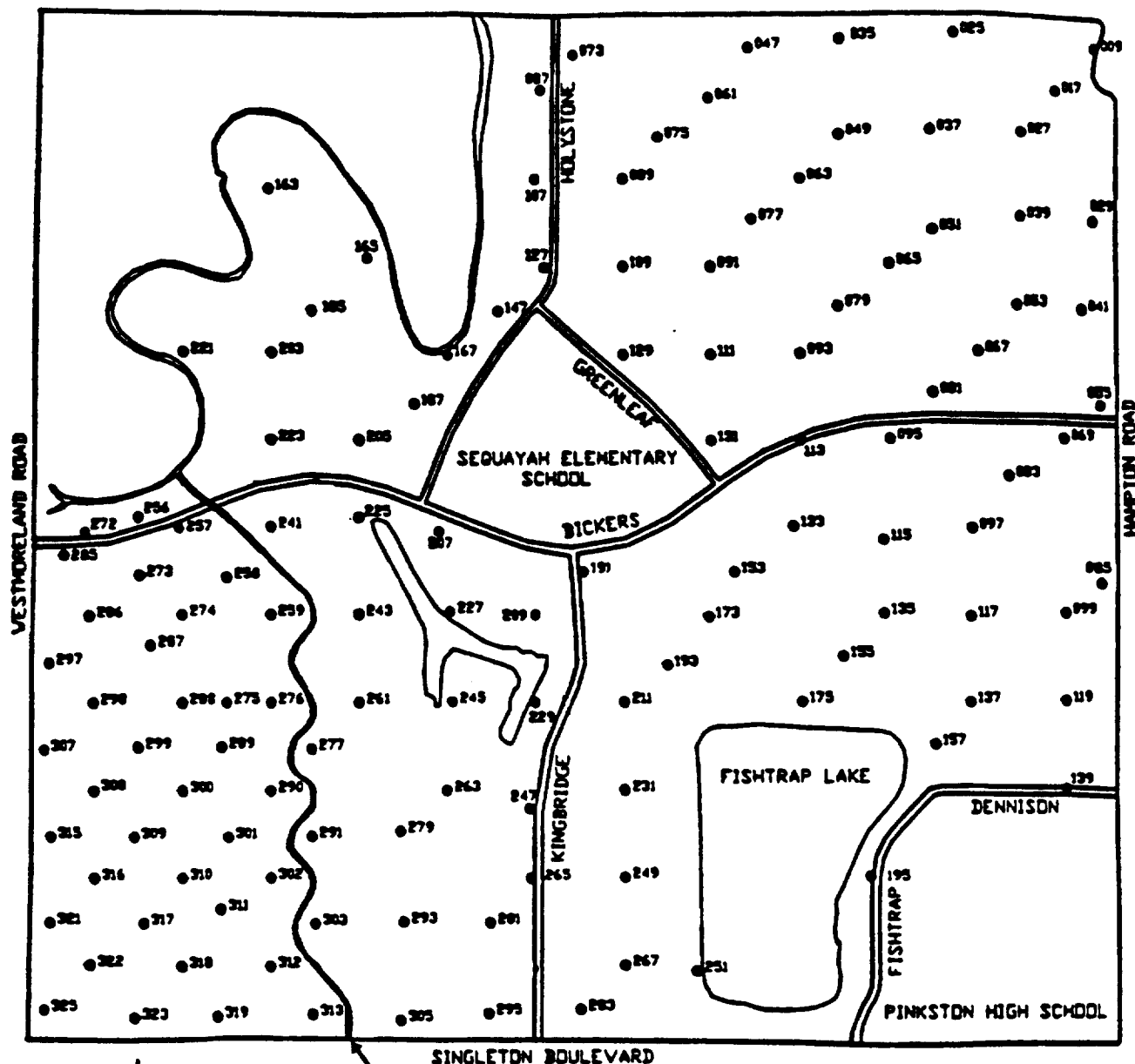
The ground conductivity meter to be used at the DHA site will be the Geonics EM-31 instrument. Survey transects have been designed to locate and outline potential waste disposal sites and provide background conductivity information. The survey transects that are proposed for the DHA site shown in Figure 2-3 were selected based on aerial photos.

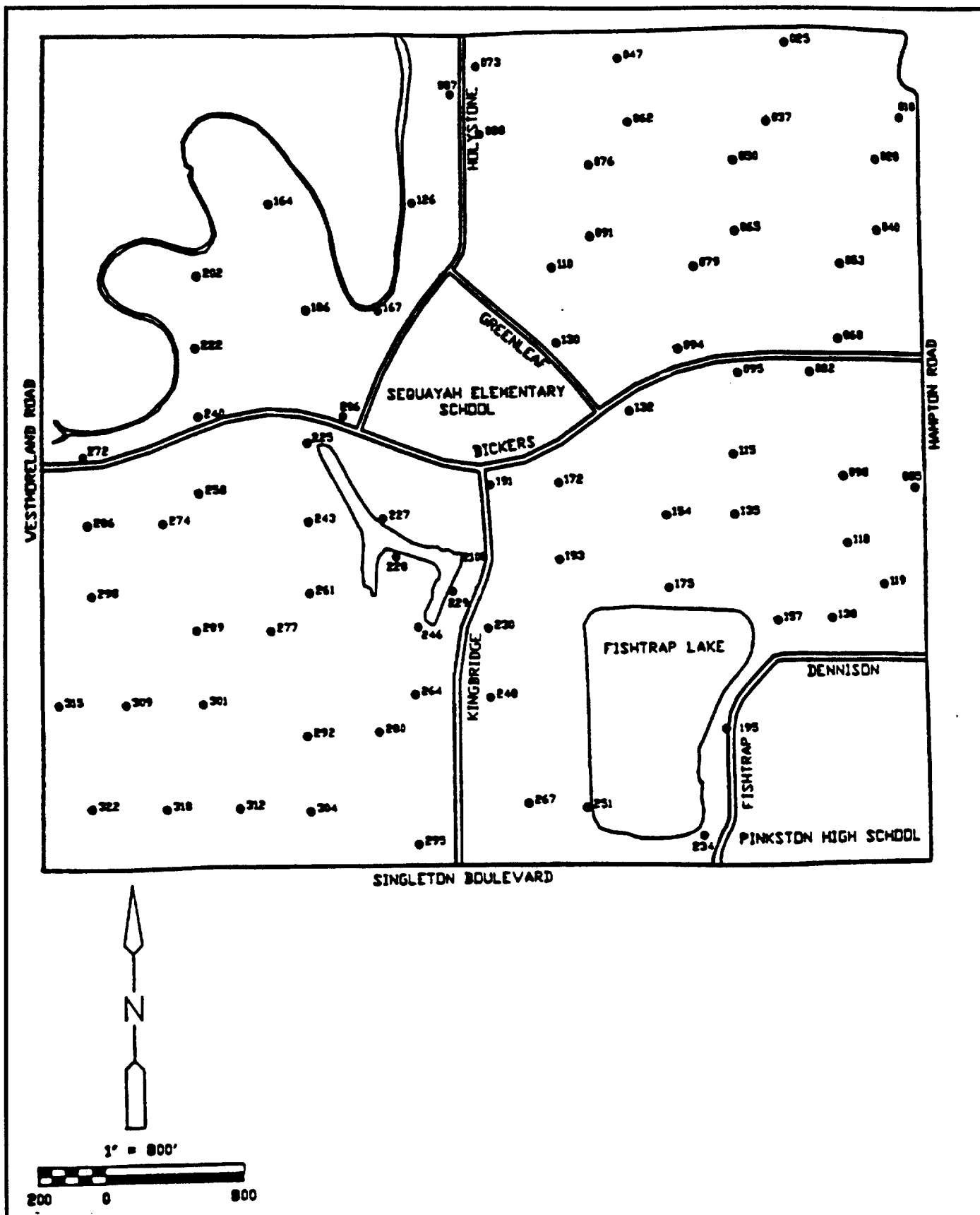
Subsurface Soil Sampling

Near-surface geophysical surveys, conducted using an EM-31, will be performed prior to conducting the intrusive sampling to help focus investigative efforts used to characterize the fill areas in the central portion of the site. Transverses across the filled area west of Fishtrap Lake, the landfill area north of Navarro Elementary School and in the vicinity of the former West Lagoon will be performed to identify subsurface anomalies, and the data gathered will be used to determine exact placement of the additional monitor wells and borings.

The proposed monitor well and boring locations were selected to achieve the following objectives:

- Collecting data for the Human Health/Ecological Impact Evaluation,
- Collecting data to assist in predicting the fate and mobility of the contaminants in the soils,
- Determine background soil contaminant concentrations,
- Determine the volume of soil and deleterious fill materials with contaminant concentrations above clean-up goals, and





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Primary and Secondary Grid Sampling Locations
to be Re-analyzed for Target Analyte List

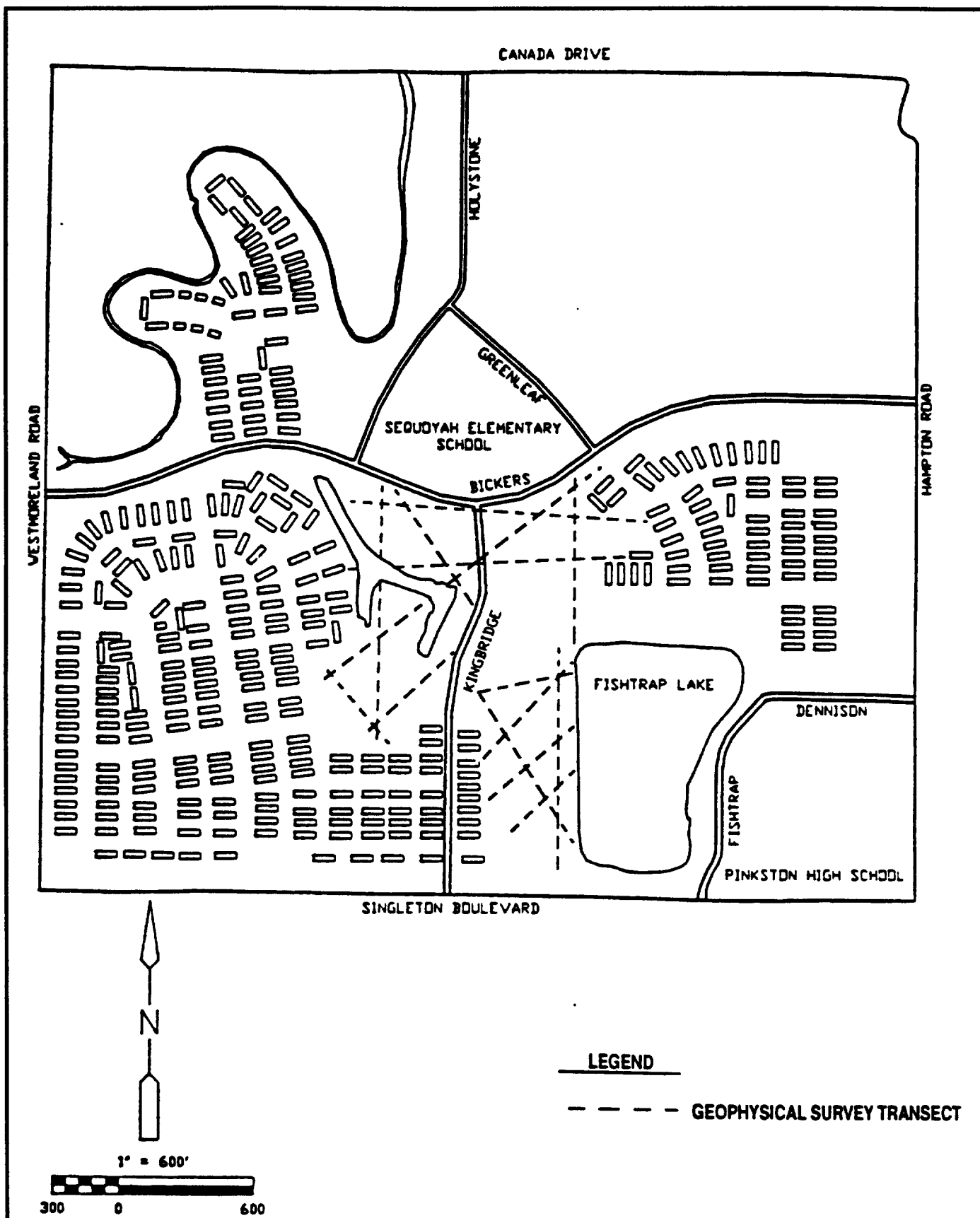
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Figure No. 2-2

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Geophysical Survey of Suspected Fill Areas

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Figure No. 2-3

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- Preliminary determination of nature and extent of landfill material.

Monitoring wells and soil borings installed during the intrusive sampling program will be sited based upon the results of the geophysical surveys, as well as information acquired by previous investigators. The additional monitor wells are located adjacent to or down gradient of suspected or potential source areas. The borings will serve to delineate the extent of the fill areas.

Currently, it is anticipated that four additional monitor wells and eight soil borings will be required to better delineate the extent and nature of the fill areas. Figure 2-4 identifies the existing wells and borings and the approximate locations of the proposed monitoring wells and borings.

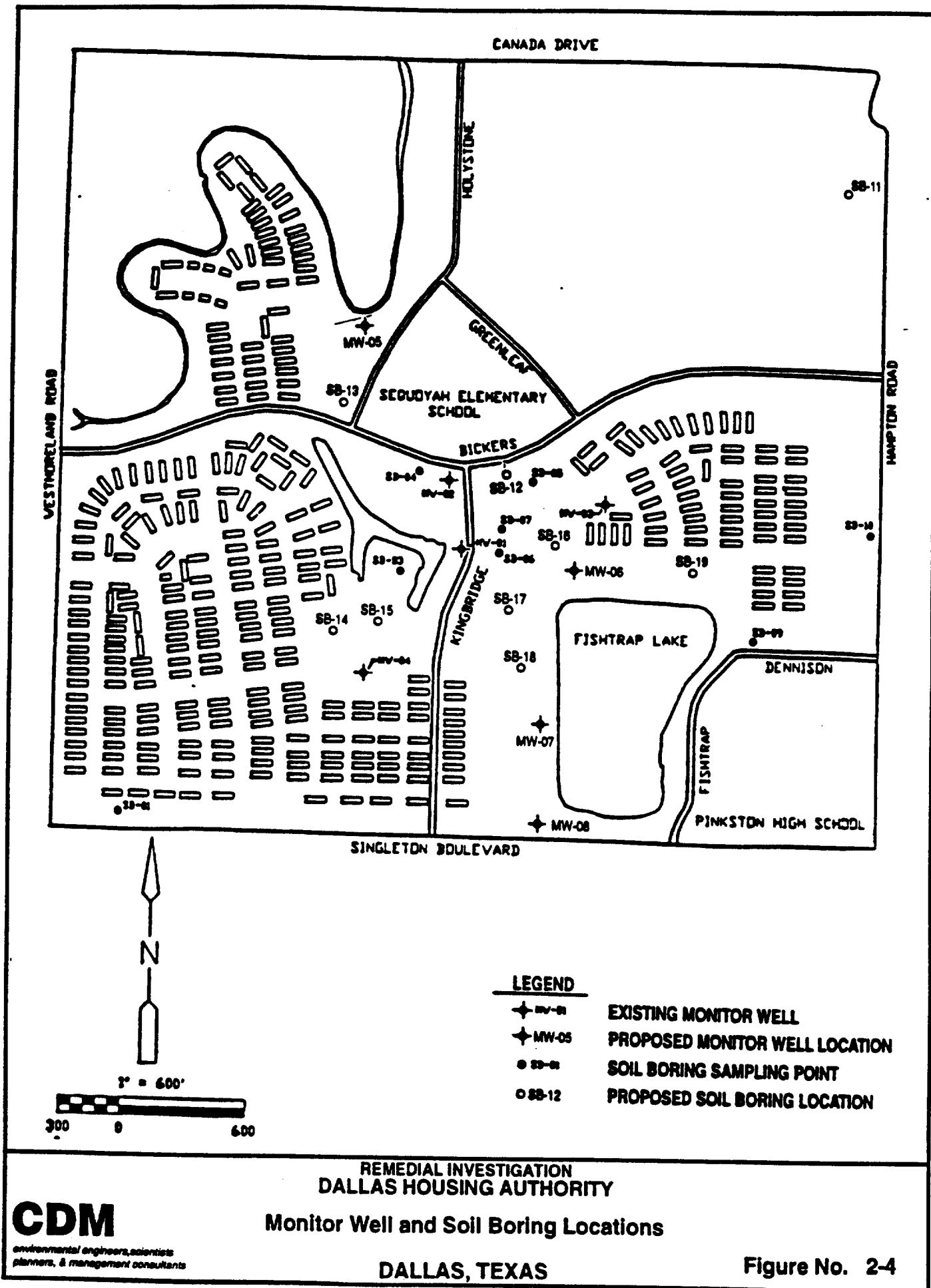
The following three soil/waste samples will be collected from each drilling location: the surface, the vadose zone and the saturated zone. Samples will be collected from each 2.5 foot split-spoon interval, or 5 foot continuous sampler. All surface and subsurface samples will be analyzed for TAL metals only. One subsurface sample from each location will be selected based on field observations (i.e., PID readings, waste observed, etc.) and analyzed for TAL/TCL in order to identify any additional contaminants of concern. A representative sample from each subsurface location will also be analyzed for total organic carbon, grain size distribution and percent moisture. The latter analyses are prescribed to aid in contaminant transport analyses.

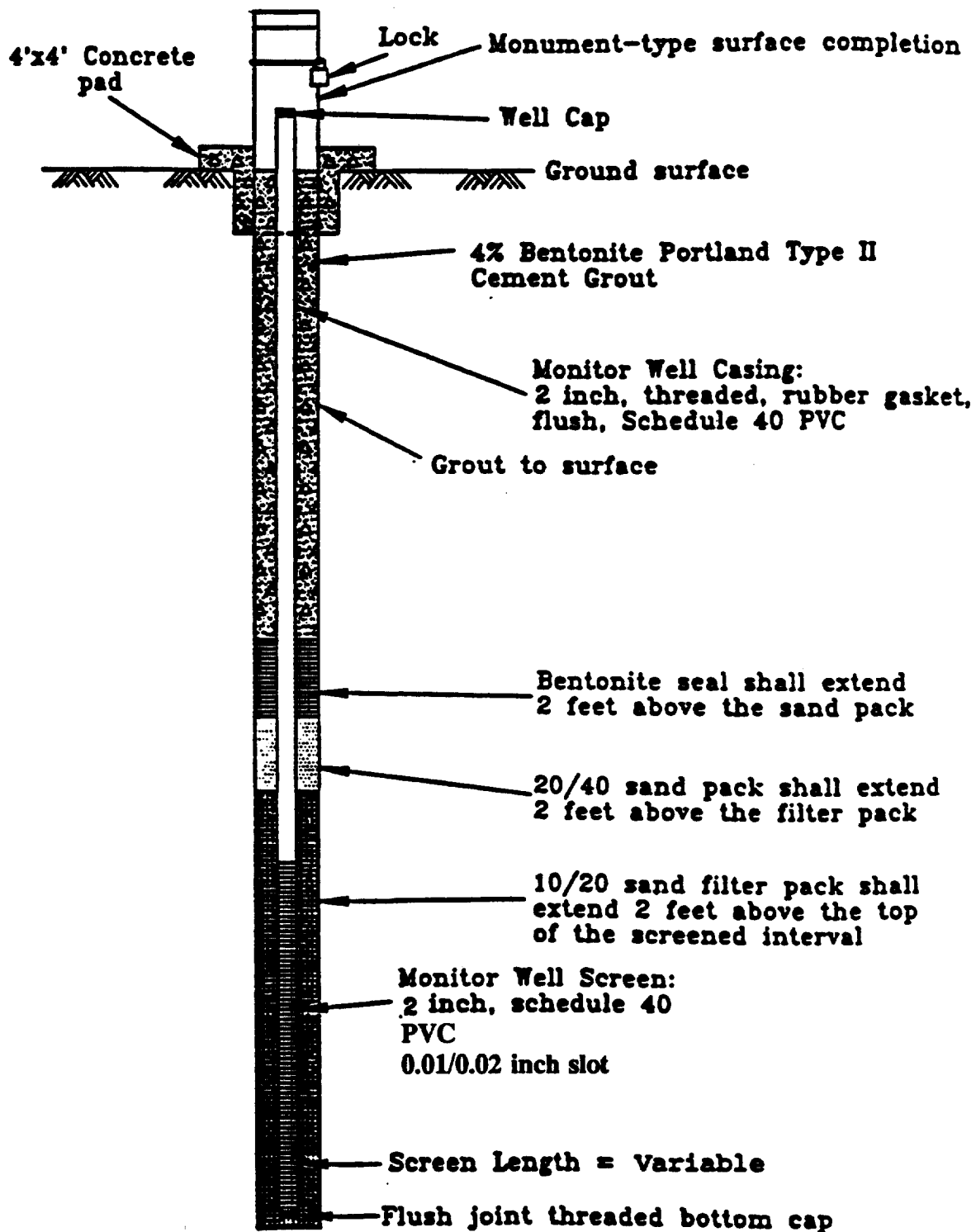
Groundwater

Groundwater beneath the DHA Site will be sampled by installing monitoring wells into the uppermost water bearing zone. The field activities related to investigations of the groundwater have the following objectives:

- Determine if contaminants associated with the soils and fill materials are leaching to groundwater,
- Determine groundwater flow direction,
- Determine contaminant extent (if present),
- Determine background contaminant concentrations,
- Characterize hydraulic properties of the upper water bearing zone (if contamination is present),
- Estimate contaminant migration, and
- Evaluate contaminant fate in the groundwater (i.e. identification of migration pathways, discharge points and groundwater users).

To achieve these objectives, four additional shallow monitor wells will be installed as shown in Figure 2-4. A typical well installation diagram is provided as Figure 2-5. The placement of the screen will be determined based on field observations. The local gradient of the upper water bearing zone will be determined based on piezometric measurements from all eight wells.





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TYPICAL WELL CONSTRUCTION DIAGRAM

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FIGURE 2-5

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Assuming groundwater flow direction is north to northwest this configuration will result in up-gradient, down-gradient, and cross-gradient wells.

If groundwater contamination is identified, step drawdown testing of the new and old wells will be conducted in order to characterize the hydraulic properties of the upper water bearing zone. Understanding the hydraulic properties is essential to calculating contaminant migration rates and identifying migration pathways that may exist to an underlying water bearing zone. Migration pathways must be present for surface contamination to impact the second or third water bearing zone.

All groundwater samples collected will be analyzed for TCL/TAL parameters. Both filtered and unfiltered groundwater samples will be collected for TAL analyses. New and existing wells will be sampled. Analysis of the laboratory data and hydraulic gradient data will result in background groundwater quality data (upgradient well), determining if the groundwater has been impacted, and subsequent characterization of contaminant distribution (isoconcentration lines). Only one round of groundwater sampling is planned for the RI.

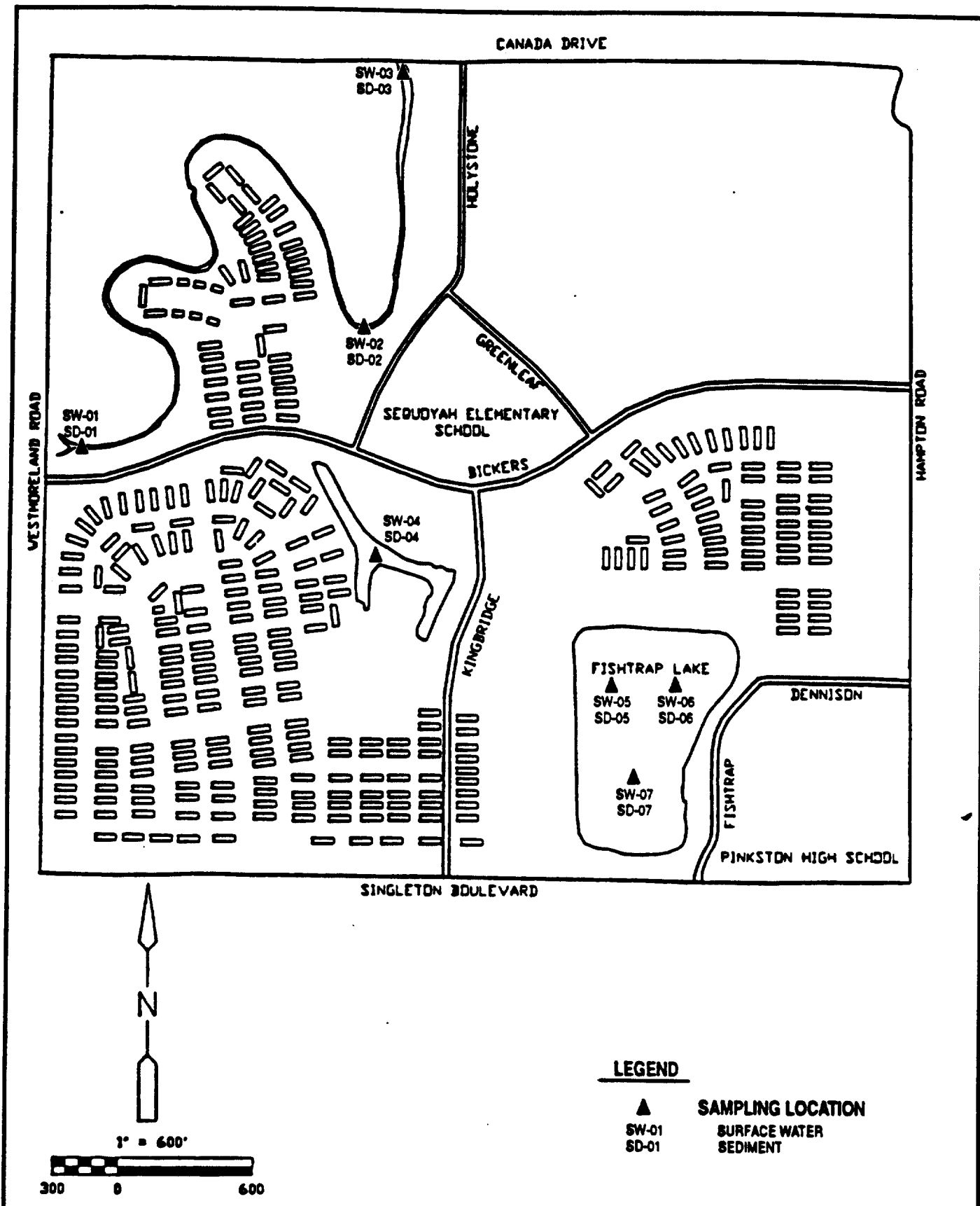
Surface Water/Sediment

The objective of this activity is to define the nature and extent of contamination in surface waters and sediments on or adjacent to the DHA Site. Specific objectives are as follows:

- Determine background contaminant concentrations,
- Determine the extent of contamination in surface waters and sediments,
- Determine the impact of site activities on surface water and sediments, and
- Evaluate surface water hydrology, including drainage patterns, flow, and surface water/groundwater relationships as necessary.

Seven locations will be sampled for surface water and sediments. Samples will be collected off-site from the West Fork of the Trinity River at the northern border of the site. On-site samples will be collected from Fishtrap Lake and the drainage channel that was the former West Lagoon. Figure 2-6 shows the approximate locations where these samples will be taken.

Two sediment samples from each location will be selected in order to characterize the sediments and underlying soils. A core sampler will be driven approximately one foot below the mud-line to collect these samples. The sample will be subdivided into two samples in order to profile the sediment column. Surface water samples will be co-located with the sediment samples and will be collected to characterize the water quality.



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Surface Water and Sediment Sampling Locations

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Figure No. 2-6

3

Section Three

Section 3

Sampling Equipment and Procedures

Sampling Equipment

A list of sampling equipment for collection of soil, ground water, surface water and sediment samples at the DHA site is presented in Table 3-1.

Soil samples will be collected from soil boreholes installed by a drilling rig. Soil samples will be collected with a 5-foot continuous sampler or 2.5 foot split-spoon. Soil samples will be "screened" for VOCs using a Thermo organic vapor monitor (OVM) with 10.0 eV lamp or HNU photo-ionization detector (PID) with 9.8 eV lamp. Both of the above PID instruments use 100 ppm isobutylene for calibration. Other equipment/supplies utilized in the sampling process will include a stainless steel mixing bowl, trowel, and sampling jars and bottles.

Ground water samples will be collected from the four 2-inch diameter monitor wells installed at the DHA site during the site investigation (1991/1992) and four additional wells proposed for installation during the RI. Wells will be purged with either a peristaltic pump or PVC bailer. Three to five well volumes will be purged from each well prior to sampling. At least 10 well volumes will be purged from the one new well for development.

Water levels in wells will be measured with an electronic water level indicator. Conductivity and temperature will be measured using an electrical conductivity meter such as the YSI S-C-T meter. The pH of the water will be measured from a field portable kit using appropriate standards for daily calibration.

Ground water samples from the monitor wells will consist of both unfiltered and field filtered samples. The samples will be filtered with an in-line 0.45 um filter. Field filtering can be performed with an in-line filter only when used with a peristaltic pump. The Geotech Flex Filter is recommended if a bailer is used to collect ground water.

Surface water samples will be collected with either a Wildco Alpha sampler or PVC bailer. Samples from Fishtrap Lake may require a boat for access. Care must be exercised to avoid stirring of sediments during the sampling process.

Sediment samples will be collected during the RI/FS with a Wildco core sampler. Samples will be collected at the bottom of water bodies from the 0 to 6 inch depth, 6-12 inch depth or from underlying soils if practicable.

Table 3-1

**Field Sampling Plan
Equipment List**

Dallas Housing Authority

Soil
<ul style="list-style-type: none">■ Drill Rig with hollow steam auger (subcontractor)■ 5' continuous sampler or 2.5 foot split spoon sampler (subcontractor)■ Thermo OVM with 10.0 eV lamp or HNU PID with 9.8 eV lamp■ 100 ppm Isobutylene Gas (calibration gas)■ Stainless Steel Mixing bowls■ Stainless Steel Trowel■ Measuring Tape■ Compass■ Camera■ Plastic Sheeting
Ground Water
<ul style="list-style-type: none">■ Drilling rig with hollow stem auger (subcontractor)■ Thermo OVM with 10.0 eV lamp and calibration gas■ 100 ppm Isobutylene Gas (calibration gas)■ 4' PVC bailer■ Peristaltic pump (Geopump)■ Geotech in-line 0.45 um filter or Flex Filter■ Polyethylene tubing■ Water level indicator■ pH meter■ YSI S-C-T meter
Surface Water
<ul style="list-style-type: none">■ Wildco Alpha Beta Sampler or PVC Bailer■ Boat■ Waders■ pH Meter■ YSI S-C-T Meter■ Life Preserver
Sediments
<ul style="list-style-type: none">■ Wildco Core Sampler or SS Hand Auger■ Boat■ Stainless Steel Mixing Bowl■ Stainless Steel Trowel
Health and Safety
<ul style="list-style-type: none">■ Tyvek or Saranex■ Outer Boots■ Gloves (Cloth and Latex)■ Hard Hat■ Respirator (Full Face for Backup)■ Respirator Cartridges

Sampling Procedures

Step-by-step instructions for field sampling are provided in this section of the FSP. The proposed field sampling will include: (1) soil borehole sampling; (2) groundwater; (3) surface water; and (4) sediments.

Soil Sampling

Soil samples will be collected at a minimum of three locations of the DHA site. Soil samples will be collected as follows:

1. Locate sample point on field map and aerial photograph.
2. Travel to sampling location. Double check locations of utilities, especially overhead power lines.
3. Locate the flagged sampling location.
4. Begin field log book notations (team leader).
5. Clearly describe the sampling point location.
6. Sketch sampling location in field log book.
7. Note orientation of 35mm photograph to be taken of sampling location.
8. Place the sample location identification sign by center stake.
9. Calibrate and test monitoring equipment such as PID.
10. Complete various details in field log book such as film roll and number, weather conditions, field personnel, etc.
11. Make sure auger flights of drilling rig have been properly cleaned.
12. Decontaminate (alconox wash and deionized water rinse) all equipment used in the sample collection process (e.g., trowel and bowl).
13. Set up table or bench with plastic covering to check samples as they come from driller.
14. Put on clean disposable latex gloves prior to handling equipment and samples.
15. Begin drilling borehole with 5-foot continuous sampler or 2.5-foot split-spoon and hollow stem auger flights.
16. Decontaminate samplers after collection of soil.

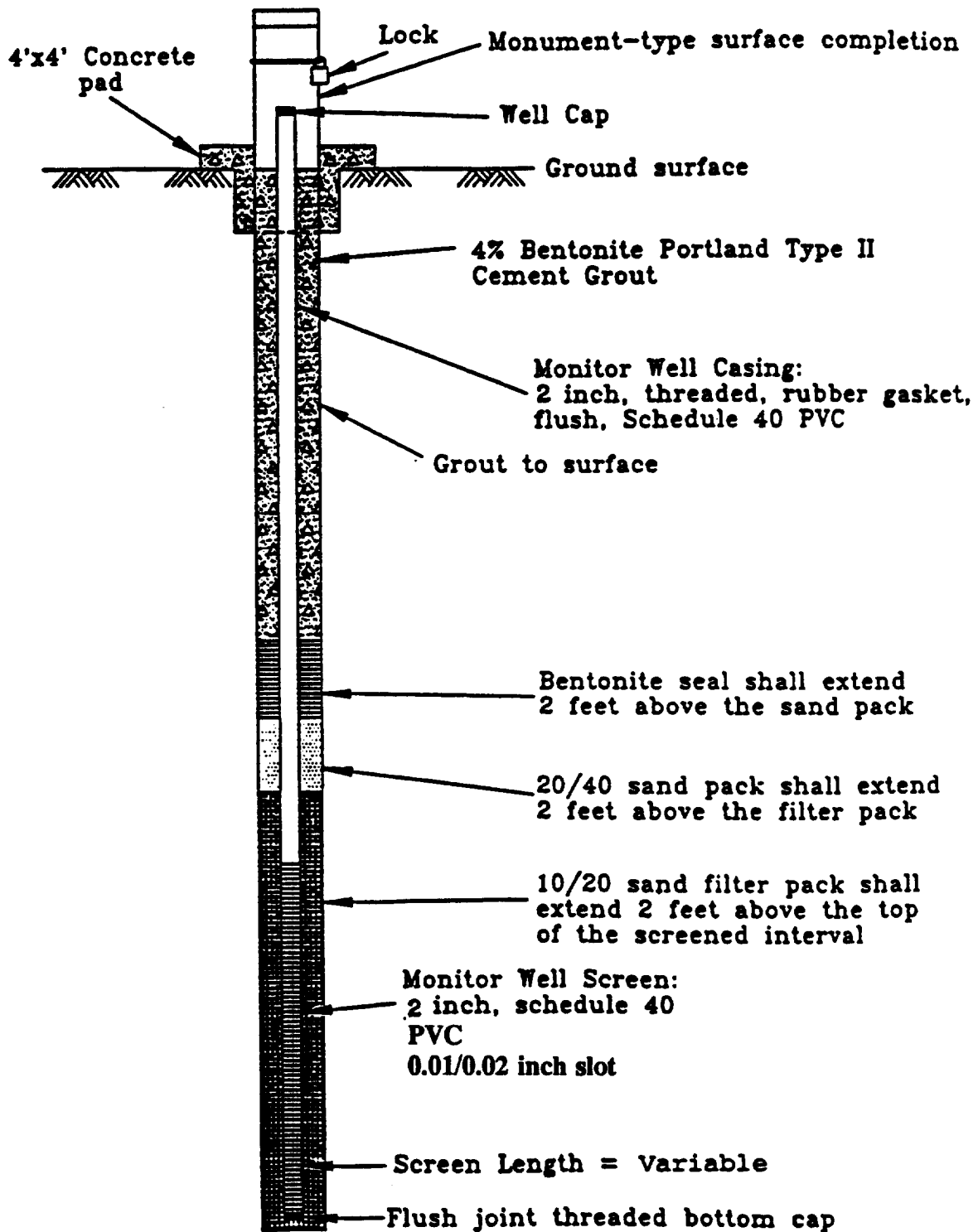
17. Screen soil samples for volatile compounds using the PID and collect soil with high PID readings (grab sample from split-spoon).
18. Inspect samples for smelter slag and battery chips.
19. Remove grab sample from split-spoon for VOC analysis. Do not mix sample. Remove the remaining soil from split-spoon and place in mixing bowl (composite sample).
20. Collect additional soil samples (grabs) based on visual inspection, odor, and/or PID measurements.
21. Describe the soil materials in the field log book for each depth interval. Note water level depth in borehole (if present).
22. Drill approximately 6 to 12 inches into the native bedrock (Eagle Ford formation).
23. Place samples in cooler. Cool to approximately 4°C with ice in double-sealed plastic bags.
24. Following drilling of the borehole and sampling, the entire borehole will be grouted up to the soil surface.
25. Auger cuttings will be put into steel 55-gallon drums to be disposed on the basis of analytical results. Drums will be closed.
26. Decontaminate all sampling equipment.
27. Complete field log book and move to next location.
28. Ship samples to the NDRC Laboratory every one to two days, or as needed.
29. Place auger cuttings in 55-gallon drums, mark drums with soil boring number and date.

Ground Water Sampling

Ground water samples will be collected at the DHA site from eight monitor wells in the Kingbridge Park area. The procedures for the installation of monitor well(s) and collection of ground water samples is described below.

1. Locate sample point on field map.
2. Travel to sampling location.
3. Locate the flagged sampling location. Double check location of utilities, especially overhead power lines.
4. Begin field log book notations (field team leader).

5. Make sure someone else can locate sampling point from your notes.
6. Sketch sampling location in field log book.
7. Note orientation of 35mm photograph to be taken of sampling location.
8. Place the sample location identification sign by center stake.
9. Calibrate and test monitoring equipment such as PID.
10. Complete field log book regarding various details such as film roll and photograph number, weather conditions, field sampling personnel, etc.
11. Make sure auger flights of drilling rig have been properly cleaned.
12. Decontaminate (alconox wash and deionized water rinse) equipment.
13. Inspect monitor well supplies according to specifications given to driller.
14. Set up table or bench with plastic covering to check soil samples as they come from driller.
15. Begin drilling borehole with 5-foot continuous sampler and hollow stem auger flights.
16. Check soil samples for volatile compounds using the PID and collect any soil with high PID readings for analysis of headspace gas (e.g., place soil in plastic bag and scan with PID).
17. Inspect samples for smelter slag and battery chips.
18. Describe the soil material in the field log book for each depth interval. Note water level depth in borehole.
19. Drill approximately 6 to 12 inches into the native bedrock, which should be a blue gray color (Eagle Ford formation).
20. Following drilling of the borehole, the monitor well will be installed.
21. Monitor well(s) will be designed according to the following specifications as shown in Figure 3-1:
 - flush threaded, 2-inch diameter PVC riser and 0.01/0.02-inch PVC slot screen;
 - 10-foot well screen beginning from just above the water table (well screen placement will be based on field observations);
 - 10/20 silica sand filter pack;



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FIGURE 3-1

- Sand pack at least 2-feet above the well screen followed in ascending order by bentonite grout, and Portland cement; and
 - Flush mounted well completion with 2-foot by 2-foot concrete pad and locking cap.
22. Immediately following installation, well(s) will be developed. Approximately 10 well volumes of water will be purged from each well. Existing wells should not be developed.
 23. Prior to sampling and at least 24-hours after development, the water level in wells will be measured.
 24. Following water level measurement, the wells will be purged. At least 3 to 5 well volumes of water will be purged from each well (or enough water to stabilize pH and conductivity readings to within 10%). Samples will be collected after the wells have returned to their static water level. Electrical conductivity, pH, and turbidity (visual) will be noted for each gallon of water purged. Purge water will be emptied into 55-gallon drums with liners and lid.
 25. Following purging, ground water samples will be collected.
 26. Collect unfiltered samples directly from peristaltic pump discharge line. Filtered samples will be collected by attaching the 0.45 μ m in-line filter or flex filter.
 27. Samples analyzed for metals must be acidified with nitric acid to a pH of less than 2. Place samples in cooler and maintain temperature at approximately 4°C.
 28. Determine the electrical conductivity and pH of the ground water in each well.
 29. Lock wells.
 20. Complete field log book and move to next location.
 31. Ship samples to analytical laboratories at the end of each day.

Development and purge water will be put into 55-gallon drums for temporary storage. Each drum will be marked according to the monitor well from which its contents came. Drums and contents will be disposed according to the analytical results of the ground water. Drums will be moved behind the DHA's Rupert Street maintenance facility for temporary storage.

Surface Water Sampling

Surface water samples will be collected from the existing water bodies at the DHA site. Sample locations will include Fishtrap Lake the former West Lagoon and west fork of the Trinity River. Water samples collected from

Fishtrap Lake may require the use of a small boat. In this case, life preservers must be worn by all persons. Surface water samples will be collected in the manner described below.

1. Locate sample point on field map.
2. Travel to sampling location.
3. Begin field log book notations (team leader).
4. Take two photographs of sampling location.
5. Complete various details in field log book such as film roll and photograph number, weather condition, field sampling personnel, etc.
6. Decontaminate sampling equipment withalconox wash and deionized water rinse.
7. Collect water sample from approximately the one foot depth with either the Wildco water sampler (Alpha Beta sampler) or PVC bailer.
8. Empty samples into appropriate sample bottles containing nitric acid (pH of less than 2).
9. Place sample into cooler with ice to maintain temperature at approximately 4°C.
10. Complete field log book and move to next sampling location.
11. Send or drop off samples to analytical laboratory(ies) at the end of the day.

Sediment Samples

Sediments samples will be collected from water bodies present at the DHA site. Collection of sediment samples from Fishtrap lake may require the use of a small boat. In this case, life preservers must be worn by all persons. Sediment sampling will be conducted in the manner described below.

1. Locate sample point on field map.
2. Travel to sampling location.
3. Begin field log book notations (team leader).
4. Take three photographs of sampling location or buoy.
5. Complete in field log book various details such as film roll and photograph number, condition of apartment, field sampling personnel, etc.

6. Collect sediment with Wildco core sampler or hand auger. Samples should be collected from the 0 to 6 inch and 6 to 12 inch depths or underlying native soils.
7. Place samples in appropriate sample jars. Put jars into cooler with ice in double-sealed plastic bags (cool to approximately 4°C).
8. Complete field log book and move to next sampling location.
9. Send samples to analytical laboratory(ies) at the end of each day via overnight delivery.

At the end of each day, the chain-of-custody will be filled out for all samples collected at the DHA site and put into the appropriate cooler(s).

Waste Samples

Waste generated from the RI/FS samples will be stored onsite in 55-gallon drums. Sampling will be conducted as outlined below.

1. Identify drums of similar materials (i.e., soil or water).
2. Collect representative samples from drum (at least four grab samples for each drum) and put into stainless steel mixing bowl.
3. Mix sample thoroughly and put into sampling jars.
4. Preserve as required based on the sample type and analyses.
5. Complete field log book.
6. Send samples to analytical laboratory(ies) as needed via overnight delivery or laboratory pickup.

4

Section
Four

Section 4

Sample Designation

Sample tracking and documentation will involve the use of field log books, sample preparation and tracking log books, field maps, site photography, sample labeling, and chain-of-custody forms. These procedures allow tracking of each sample from the time of collection through the preparation process to receipt by the laboratory.

Field Sampling Operations

Field sampling custody and documentation will include sample log books, log sheets, field maps, site photography, and sample labeling and chain-of-custody forms.

Log Books

Each sampling field team leader will use a log book to record all sampling activities. Field log books will be numbered and bound. In the field log books, team leaders will record the date and time of sample collection, the sampling location, the sample identification number, sampling personnel and others present, weather and other conditions at the site, a photographic log, and other pertinent sampling events in chronological order.

The field team leader will use separate, prenumbered and bound log books to record information pertinent to the RI/FS. The task leader will document the major activities of the sampling, along with any additions to or deviations from planned activities. A designated field task leader will document all information concerning sample collection, custody and documentation.

Sampling during the Remedial Investigation will include soil, groundwater, surface water, and sediments. Each of the samples from the above media will be assigned unique identification numbers based on the following protocol:

- The first two digits will represent the project identification code and will be "RI";
- The next two characters will identify the location (e.g., MW for monitor well or SB for soil boring);
- The location code will be followed by a two or three digit code indicating the site location (i.e., MW-01 through 08 or SB-11 through 19);

- Site location codes for surface and subsurface soil samples will be followed by another code indicating the sample depth interval (i.e., 0-1 inch or 5-6 feet, etc.)

For example, the sample identification number: RI-SB-11 (5-6 foot) would indicate a subsurface soil sample collected from soil boring 11 at the 5 to 6 foot interval. Identification codes for the different media will be as follows:

- Soil Borings - SB;
- Monitor Wells - MW;
- Surface Water - SW;
- Sediment - SD; and
- Waste samples from auger cuttings, monitor well purging, or decontamination water - WW.

Sample identification numbers will be assigned by the task leader prior to sample collection utilizing the information in Section 2 of this plan.

Sample Tags

Each collected sample will have a completely filled-in sample tag securely attached to it. Tags will include the Project code, location of sampling site, type of sample, analyses required, time of sampling and the initials of the Sampler.

Following collection of each sample depth, the complete sample identification number will be marked on the sample container and lid. Soil, groundwater, surface water, and sediment sample bottles received from the laboratory will be appropriately labeled with an indelible marker. All samples will remain in custody of the team leaders until they are relinquished at the field facility.

All samples will be shipped (or picked up by couriers) under chain-of-custody either daily or every two days to the analytical laboratory. The field task leader will document all shipments in the sample log book.

Chain-of-Custody Record Sheets

Custody records will be used for the samples collected at the DHA Site. The forms will be correlated with the sample collection tags; requested information will have the same heading on both. The sampler or sample custodian will complete a Chain-of-Custody Record to accompany each sample shipment from the field to the laboratory. A sample Chain-of-Custody form is provided at the end of this section as Figure 4-1.

The custody records will be used for a packaged lot of samples; more than one sample will usually be recorded on one form. More than one custody record sheet may be used for one package, if necessary. Their purpose is to document the transfer of a group of samples traveling together; when the group of samples changes the custody record is updated.

General use instructions follow:

Using a Two-Part Custody Record Sheet

- The originator fills in all requested information from the sample tags.
- The originator signs in the "Relinquished by" box and keeps the copy.
- The original record sheet travels with the samples.
- The person receiving custody checks the sample tag information against the custody record. They also check sample condition and notes anything unusual under "Comments" on the custody form.
- The person receiving custody signs in the adjacent "Received by" box and keeps the original.
- The Date/Time will be the same for both signatures since custody must be transferred to another person. When samples are shipped via common carrier (e.g., Federal Express), the date/time will not be the same for both signatures.
- When samples are shipped via common carrier, the original travels with the samples and the shipper (e.g., Field Sample Custodian) keeps the copy. Shipping papers, bills of lading, etc. are considered as part of the chain-of-custody documentation.
- In all cases, it must be readily seen that the same person receiving custody has relinquished it to the next custodian.
- If samples are left unattended or a person refuses to sign, this must be documented and explained on the custody record.

Questions/Problems Concerning Custody Records

If a discrepancy between sample tag numbers and custody record listings is found, the person receiving custody should document this and properly store the samples. The samples should not be analyzed until the problem is resolved by contacting the field sample custodian or other designated responsible authority; e.g., the appropriate QA coordinator.

The responsible person receiving custody should attempt to resolve the problem by checking all available information (other markings on sample container, type of sample, etc.). He should then document the situation on the custody record and in his project logbook and notify the appropriate sample custodian by the fastest available means, followed by written notification.

Changes may be written in the "Comments" section of the Custody record and should be initialed and dated. A copy of this record should accompany the written notification to the sample custodian. A complete copy of the documentation of the problem and its resolution should also be provided to the QA coordinator and submitted to the project files.

Laboratory Custody Procedures

The CLP laboratories routinely work with CLP custody procedures and will implement them for this work assignment. Non-CLP laboratories will use sample identification records and custody records to satisfy the CLP or equivalent requirements. These requirements are outlined below:

- Upon receipt at the laboratory, each sample shipment will be inspected to assess the condition of the shipping container and the individual samples, and the condition or integrity of the custody seals on a received shipment of samples will be documented at the time of receipt of the laboratory.
- Enclosed chain-of-custody records will be cross-referenced with all the samples in the shipment; these records will be signed by the sample custodian and placed in the project file.
- Sample custodian will continue the chain-of-custody by assigning a unique laboratory number to each sample on receipt; this number identifies the sample through all further handling.
- Internal log books and records that maintain the chain-of-custody throughout sample preparation and analysis, and data reporting will be kept.

Sample Shipment

Each sample shipped will be packed in accordance with Department of Transportation (DOT) regulations which include documentation requirements. In addition, each sample will be identified with a sample identification tag, and will be listed on the chain-of-custody record completed for each sample shipping container. The field sample custodian will notify the laboratory sample custodian of sample shipment.

Security

Several security measures will be implemented during the RI/FS field sampling to maintain the integrity of the samples during the collection process. In the field, samples will be maintained in the possession of team leaders, or locked inside field vehicles, until relinquished at the field facility. The field facility will be designated as a secured area, accessible by approved personnel only.

5

Section Five

Section 5

Sample Handling and Analysis

Sample Handling

Environmental samples collected at the DHA site will include soil, ground water, surface water, and sediments. The proper handling of these samples is critical to obtaining high quality and usable data. The aspects of sample handling detailed in this section include preservation methods, type of sampling containers, shipping requirements, and holding times. A summary of sample handling requirements for each analytical parameter proposed in the FSP is presented in Table 5-1.

Archived Soil

Archived soil samples from the CDM 1991/1992 soil sampling exercises will be reanalyzed for Arsenic, Cadmium and TAL on a selective basis. If any of the archived samples have insufficient volume for analyses or have been lost, CDM will resample the grid points as reconstructed from field sampling logs.

Soil

Samples to be analyzed for TCL will be removed directly from the split-spoon and placed into sampling jars. Composite soil samples consisting of soil removed from the split-spoon sampler will be mixed and placed into 500 ml wide mouth jars for analysis. No preservation is required for soil samples. Samples analyzed for TCL will, however, require cooling to 4°C. Samples will either be picked up by the laboratory (local service) or shipped to the laboratory via overnight delivery service. Holding time for TCL is seven days until extraction.

Groundwater

Ground water samples will be collected from monitor wells installed at the DHA site. Sample containers for ground water will be as follows:

- Metals: 1-liter plastic bottle;
- VOCs: 2-40 ml glass volatile organic analysis (VOA) vials;
- BNAs: 1-liter glass amber bottle; and
- Water Quality: 1-liter glass or plastic bottle.

Table 5-1

RI/FS QAPP
Analytical Methods, References, and Method Detection Limits

Dallas Housing Authority

Matrix	Parameter(s)	Sample Prep. Extraction Digest Method	Sample Analysis Method	References	MDL	Comments
Soil	Metals (Pb, As, and Cd)	Acid digest, distillation	Method 6010 (ICP)	U.S. EPA, Test Methods for Evaluating Solid Wastes, SW-846 3rd Ed., 11/86.	1-10 mg/kg	
	Inorganic Target Analyte List (TAL)	1993 SOW Extraction	1993 SOW (ICP, GFAA, CV, etc.)	U.S. EPA CLP Inorganics Statement of Work, ILM03.0	CLP-CRDLs	
	Organic Target Compound List (TCL)	1993 SOW Extraction	1993 SOW (GC/MS, GC/ECD)	U.S. EPA CLP Organics Statement of Work, OLM01.9	CLP-CRDLs	Vinyl Chloride will have a DL of 2 µg/l
	Grain Size Distribution	per Method	ASTM D-2216	American Society for Testing and Materials 1980	1 percent	
	Moisture Content	per Method	ASTM D-2216	American Society for Testing and Materials 1980	1 percent	
	Total Organic Carbon	per Method	Method 9060	U.S. EPA, Test Methods for Evaluating Solid Wastes SW-846 3rd Ed. 11/86	1 mg/kg	
Ground Water ²	Inorganic Target Analyte List (TAL)	SOW extraction	SOW	U.S. EPA CLP Inorganics Statement of Work, ILM01.0	CLP-CRDLs	
	Organic Target Compound List (TCL)	SOW extraction	SOW	U.S. EPA CLP Organics Statement of Work, OLM01.9	CLP-CRDLs	Vinyl chloride will have a DL of µg/l
	Total Dissolved Solids (TDS)	per Method	Method 160.1	U.S. EPA, Methods for the Chemical Analysis of Water and Wastes, 3/83	5 mg/l	
	Alkalinity	None	Method 310.1	U.S. EPA, Methods for the Chemical Analysis of Water and Wastes, 3/83	1.0 mg/L	

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Table 5-1 (Continued)

Matrix	Parameter(s)	Sample Prep. Extraction Digest Method	Sample Analysis Method	References	MDL	Comments
Surface Water ²	Inorganic Target Analyte List (TAL)	SOW Extraction	SOW	U.S. EPA CLP Inorganics Statement of Work 1990, ILM03.0	CLP-CRDLs	
	Organic Target Compound List (TCL)	1993 SOW Extraction	SOW	U.S. EPA CLP Organics Statement of Work 1991, OLM01.9	CLP-CRDLs	Vinyl chloride will have a DL of 2 µg/l
	Alkalinity	Filtered	Method 310.1	U.S. EPA, Methods for the Chemical Analysis of Water and Wastes, 3/83	1.0 mg/l	
	Total Suspended Solids (TSS)	per Method	Method 160.2	U.S. EPA, Methods for the Chemical Analysis Water and Wastes, 3/83	5 mg/L	
	Nitrate/Nitrite	per Method	Method 353.2	U.S. EPA, Test Methods for Evaluating Solid Wastes, SW-846, 3rd Ed., 11/86	0.01 mg/L	
	Kjeldahl Nitrogen	per Method	Method 351.4/351.2/351.3	U.S. EPA, Methods for the Chemical Analysis of Water and Wastes, 3/83	0.01 mg/L	
Sediments	Inorganic Target Analyte List (TAL)	SOW Extraction	SOW	U.S. EPA CLP Inorganics Statement of Work, ILM03.0	CLP-CRDLs	
	Organic Target Compound List (TCL)	SOW Extraction	SOW	U.S. EPA CLP Organics Statement of Work, OLM01.9	CLP-CRDLs	Vinyl chloride will have a DL of 2µg/l

NOTE: 1) Ground water also analyzed for Alkalinity, Conductivity, and Total Dissolved Solids (TDS) by Methods 310.1, 120.1, and 160.1; respectively.
 2) Surface water also analyzed for Alkalinity, Conductivity, and TDS by Method 310.1, 120.1, and 160.1; respectively.

The holding times for dissolved metals is six months. These samples will be acidified onsite with nitric acid to a pH of less than two. The holding times for analysis of organic compounds is 14 days for VOCs and seven days until extraction for BNAs. Samples analyzed for VOCs and BNAs must be cooled to approximately 4°C. VOCs will be preserved with hydrochloric acid to a pH of less than 2.

Surface Water

Seven surface water samples will be collected from the DHA site. All samples analyzed for metals will be acidified to a pH of less than 2 with nitric acid. VOCs will be preserved with hydrochloric acid to a pH of less than 2. All samples will be stored in a cooler at a temperature of approximately 4°C.

Sediments

14 sediment samples will be collected from the DHA site. All samples will be cooled to approximately 4°C.

Waste Samples

Wastes generated from the RI/FS sampling process will be collected and analyzed to ensure proper handling and disposal. These wastes are expected to include auger cuttings, purge water from the monitor wells, and decontamination water. Wastes will be put into 55-gallon drums for temporary storage. All drums will be marked with contents and dates. One composite sample will be collected from each waste stream for analysis. Samples will be collected from each drum, put into a stainless steel mixing bowl, mixed, and placed into a sample jar.

Sample Analysis

As discussed in previous sections, sampling at the DHA site will include groundwater, surface water and sediment, surface soils and subsurface soils.

Table 5-2 summarizes the number of samples to be collected per media, and the number and type of laboratory analyses to be performed. A complete list of all the parameters to be analyzed at the DHA Site and the analytical methodology is provided in Appendix A.

Archived Samples

Samples from previous CDM investigations will be re-analyzed for arsenic and cadmium, and selected samples will be re-analyzed for TAL. The purpose of this re-analysis is to define the contaminants of concern in the surface soils. Duplicate samples will be analyzed on a frequency of once every 20 samples.

TABLE 5-2
RI/FS ANALYTICAL SUMMARY
FIELD SAMPLING PLAN
DALLAS HOUSING AUTHORITY

Samples		Field QA/QC				Analyses			
Sample Media	# of Samples	Duplicates	Blind Standard	Trip Blank	Rinstate Blank	As, Cd	TCL	TAL	Others ²
Archived Soils	726	15	15	-	-	678	-	78	-
Groundwater ⁽¹⁾	16	1	1	1	-	-	10	19 ¹	-
Subsurface Soils	24	1	1	-	1	-	9	27	12
Sediments	14	1	-	-	-	-	4	15	-
Surface Water ⁽¹⁾	14	1	1	1	-	-	4	17 ¹	3
Surface Soils at Borings	12	1	-	-	1	-	-	14	-

(1) Includes filtered and nonfiltered as separate samples

(2) For soils Includes: TOC and grain size; for water Includes: TSS, alkalinity, Nitrate and Nitrite

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Surface Soils/Subsurface Soils

As previously discussed, soil samples will be collected during the installation of monitoring wells and borings. The samples will be screened using head space analyses performed in the field. Based on these results and the physical description of the soil, samples will be selected for laboratory analyses.

Analyses of the samples will allow empirical calculation of partition coefficients to be used in migration and clean-up assessments. Analyses performed for this purpose include natural organic carbon content, grain size, and moisture content.

One soil sample from each monitor well and boring will be analyzed for the full CERCLA CLP TAL/TCL analyses based on field observations. All other samples will be analyzed for TAL. One duplicate sample will be collected for every 20 soil samples collected.

Groundwater

To verify the total nature of the contaminants, the groundwater samples will be analyzed for full TCL and TAL compounds. Both filtered and unfiltered samples will be collected for TAL analyses. This includes all parameters routinely analyzed under the Superfund program including:

- Volatiles
- Semi-volatiles
- Metals and cyanide
- PCBs and pesticides

The data collected through the groundwater related activities will be evaluated in conjunction with data acquired during sampling of other media. This will provide a means for developing a thorough understanding of the fate and the extent of the contaminants such that baseline risks can be estimated.

The groundwater sampling protocol is defined more completely in Section 3.1. One duplicate or co-located sample will be collected for TAL/TCL analyses during the groundwater sampling.

Surface Water and Sediment Samples

Surface water and sediment samples will be collected from Fishtrap Lake, the former West Lagoon and the West Fork of the Trinity River. Seven water samples and 14 sediment samples will be collected from seven locations. All surface water samples will be analyzed for TAL metals. Three surface water samples will be selected at the discretion of the field team leader for TCL and general water quality analyses. One duplicate TAL/TCL sample will be collected.

Sediment samples will be collected from two intervals at each location. All sediment samples will be analyzed for TAL metals. One sediment sample

from each water body will be collected and analyzed for TCL. One TAL/TCL duplicate will be selected at the discretion of the field team leader.

Travel/Trip Blank

A travel blank consists of a set of sample containers filled in a location away from the site with deionized or other analyte-free water taken to the sampling site, and returned along with the field samples to the laboratory without having been opened in the field. This water preferably should be of the same quality as the method blank water used by the laboratory performing the specific analysis. These travel blanks will be handled and transported in the same manner as the samples acquired on a given day. For the purposes of this investigation two travel/trip blanks will be included. These samples will be analyzed for VOAs (Method 8240).

Decontamination Rinsate Blank

A decontamination rinsate blank consists of rinsate water from the final stage of the sampling equipment decontamination process. A decontamination rinsate blank will be collected for every 20 soil samples collected. [Groundwater samples will be collected using dedicated or disposal bailers.] All rinsate blank samples will be analyzed for TAL metals.

Field Blank

Field blanks will be collected at a frequency of one for every 20 field samples collected during the field activities.

For each type of sample collected, a sample container will be randomly selected and filled with analyte free water in the same manner as a collected sample. This will simulate actual site conditions and provide verification that sample handling and collection procedures have or have not affected the quality of the sample analyses. No field blanks will be analyzed unless trip or rinsate blanks are contaminated.

Triplicate Volume

Triple sample volumes will be collected at a frequency of one per 20 samples. These additional sample containers will be labeled "for matrix spike/matrix spike duplicate" and will be used by the laboratory for their internal quality control.

A

Appendix A

APPENDIX A
INORGANIC TARGET ANALYTE LIST

INORGANIC TARGET ANALYTE LIST (TAL)

Analyte	Contract Required Detection Limit ^(1,2) (ug/L)
Aluminum	200
Antimony	60
Arsenic	10
Barium	200
Beryllium	5
Cadmium	5
Calcium	5000
Chromium	10
Cobalt	50
Copper	25
Iron	100
Lead	3
Magnesium	5000
Manganese	15
Mercury	0.2
Nickel	40
Potassium	5000
Selenium	5
Silver	10
Sodium	5000
Thallium	10
Vanadium	50
Zinc	20
Cyanide	10

- (1) Subject to the restrictions specified in the first page of Part C, Section IV of Exhibit D (Alternate Methods - Catastrophic Failure) any analytical method specified in SOW Exhibit D may be utilized as long as the documented instrument or method detection limits meet the Contract Required Detection Limit (CRDL) requirements. Higher detection limits may only be used in the following circumstance:

If the sample concentration exceeds five times the detection limit of the instrument or method in use, the value may be reported even though the instrument or method detection limit may not equal the Contract Required Detection Limit. This is illustrated in the example below:

For lead:

Method in use = ICP

Instrument Detection Limit (IDL) = 40

Sample concentration = 220

Contract Required Detection Limit (CRDL) = 3

**TARGET COMPOUND LIST (TCL) AND
CONTRACT REQUIRED QUANTITATION LIMITS (CRQL)**

NOTE: The values in these tables are quantitation limits, not absolute detection limits. The amount of material necessary to produce a detector response that can be identified and reliably quantified is greater than that needed to simply be detected above the background noise. The quantitation limits in these tables are set at the concentrations in the sample equivalent to the concentration of the lowest calibration standard analyzed for each analyte.

Specific quantitation limits are highly matrix dependent. The quantitation limits listed herein are provided for guidance and may not always be achievable.

The CRQL values listed on the following pages are based on the analysis of samples according the specifications given in Exhibit D. For each fraction and matrix, a brief synopsis of the sampling handling and analysis steps is given, along with an example calculation for the CRQL value. All CRQL values are rounded to two significant figures. For soil samples, the moisture content of the samples is not considered in these example calculations.

TARGET COMPOUND LIST (TCL) AND CONTRACT REQUIRED QUANTITATION LIMITS (CRQL)

Volatiles	CAS Number	Quantitation Limits*			
		Water ug/L	Low Soil ug/Kg	Med. Soil ug/Kg	On Column (ng)
1. Chloromethane	74-87-3	10	10	1200	(50)
2. Bromomethane	74-83-9	10	10	1200	(50)
3. Vinyl Chloride	75-01-4	10	10	1200	(50)
4. Chloroethane	75-00-3	10	10	1200	(50)
5. Methylene Chloride	75-09-2	10	10	1200	(50)
6. Acetone	67-64-1	10	10	1200	(50)
7. Carbon Disulfide	75-15-0	10	10	1200	(50)
8. 1,1-Dichloroethene	75-35-4	10	10	1200	(50)
9. 1,1-Dichloroethane	75-34-3	10	10	1200	(50)
10. 1,2-Dichloroethene (total)	540-59-0	10	10	1200	(50)
11. Chloroform	67-66-3	10	10	1200	(50)
12. 1,2-Dichloroethane	107-06-2	10	10	1200	(50)
13. 2-Butanone	78-93-3	10	10	1200	(50)
14. 1,1,1-Trichloroethane	71-55-6	10	10	1200	(50)
15. Carbon Tetrachloride	56-23-5	10	10	1200	(50)
16. Bromodichloromethane	75-27-4	10	10	1200	(50)
17. 1,2-Dichloropropane	78-87-5	10	10	1200	(50)
18. cis-1,3-Dichloropropene	10061-01-5	10	10	1200	(50)
19. Trichloroethene	79-01-6	10	10	1200	(50)
20. Dibromochloromethane	124-48-1	10	10	1200	(50)
21. 1,1,2-Trichloroethane	79-00-5	10	10	1200	(50)
22. Benzene	71-43-2	10	10	1200	(50)
23. trans-1,3-Dichloropropene	10061-02-6	10	10	1200	(50)
24. Bromoform	75-25-2	10	10	1200	(50)
25. 4-Methyl-2-pentanone	108-10-1	10	10	1200	(50)
26. 2-Hexanone	591-78-6	10	10	1200	(50)
27. Tetrachloroethene	127-18-4	10	10	1200	(50)
28. Toluene	108-88-3	10	10	1200	(50)
29. 1,1,2,2-Tetrachloroethane	79-34-5	10	10	1200	(50)
30. Chlorobenzene	108-90-7	10	10	1200	(50)
31. Ethyl Benzene	100-41-4	10	10	1200	(50)
32. Styrene	100-42-5	10	10	1200	(50)
33. Xylenes (Total)	1330-20-7	10	10	1200	(50)

* Quantitation limits listed for soil/sediment are based on wet weight. The quantitation limits calculated by the laboratory for soil/sediment, calculated on dry weight basis as required by the contract, will be higher.

Note that the CRQL values listed on the preceding page may not be those

specified in previous CLP Statements of Work. These values are set at concentrations in the sample equivalent to the concentration of the lowest calibration standard specified in Exhibit D VOA. Lower quantitation limits may be achievable for water samples by employing the Statement of Work for Low Concentration Water for Organic Analyses.

VOLATILES

Water Samples

A 5 mL volume of water is purged with an inert gas at ambient temperature. The volatiles are trapped on solid sorbents, and desorbed directly onto the GC/MS. For a sample with compound X at the CRQL of 10 ug/L:

$(10 \text{ ug/L}) (5 \text{ mL}) (10^{-3} \text{ L/mL}) = 50 \times 10^{-3} \text{ ug} = 50 \text{ ng}$ on the GC column

Low Level Soil/Sediment Samples

A 5 g aliquot of the soil/sediment sample is added to a volume of water in a purge tube, heated, and purged with an inert gas. The volatiles are trapped, and later desorbed directly onto the GC/MS. For a sample with compound X at the CRQL of 10 ug/Kg:

$(10 \text{ ug/Kg}) (5 \text{ g}) (10^{-3} \text{ Kg/g}) = 50 \times 10^{-3} \text{ ug} = 50 \text{ ng}$ on the GC column

Medium Level Soil/Sediment Samples

A 4 g aliquot of soil/sediment is extracted with 10 mL of methanol, and filtered through glass wool. Only 1 mL of the methanol extract is taken for screening and analysis. Based on the results of a GC/FID screen, an aliquot of the methanol extract is added to 5 mL of reagent water and purged at ambient temperature. The largest aliquot of extract considered in Exhibit D is 100 uL. For a sample with compound X at the CRQL of 1200 ug/Kg:

$(1200 \text{ ug/Kg}) (4 \text{ g}) (10^{-3} \text{ Kg/g}) = 4800 \times 10^{-3} \text{ ug} = 4800 \text{ ng}$

This material is contained in the 10 mL methanol extract:

$(4800 \text{ ng}) / 10 \text{ mL} = 480 \text{ ng/mL}$

Of which, 100 uL are purged from the reagent water.

$(480 \text{ ng/mL}) (100 \text{ uL}) (10^{-3} \text{ mL/uL}) = 480 \times 10^{-1} \text{ ng} = 50 \text{ ng}$ on the GC column

Note that for both low and medium soil/sediment samples, while it may affect the purging efficiency, the volume of reagent water used in the purging process does not affect the calculations.

TARGET COMPOUND LIST (TCL) AND CONTRACT REQUIRED QUANTITATION LIMITS (CRQL)

Semi-volatiles	CAS Number	Quantitation Limits*			On Column (ng)
		Water ug/L	Low Soil ug/Kg	Med. Soil ug/Kg	
34. Phenol	108-95-2	10	330	10000	(20)
35. bis(2-Chloroethyl) ether	111-44-4	10	330	10000	(20)
36. 2-Chlorophenol	95-57-8	10	330	10000	(20)
37. 1,3-Dichlorobenzene	541-73-1	10	330	10000	(20)
38. 1,4-Dichlorobenzene	106-46-7	10	330	10000	(20)
39. 1,2-Dichlorobenzene	95-50-1	10	330	10000	(20)
40. 2-Methylphenol	95-48-7	10	330	10000	(20)
41. 2,2'-oxybis (1-Chloropropane)*	108-60-1	10	330	10000	(20)
42. 4-Methylphenol	106-44-5	10	330	10000	(20)
43. N-Nitroso-di-n-propylamine	621-64-7	10	330	10000	(20)
44. Hexachloroethane	67-72-1	10	330	10000	(20)
45. Nitrobenzene	98-95-3	10	330	10000	(20)
46. Isophorone	78-59-1	10	330	10000	(20)
47. 2-Nitrophenol	88-75-5	10	330	10000	(20)
48. 2,4-Dimethylphenol	105-67-9	10	330	10000	(20)
49. bis(2-Chloroethoxy) methane	111-91-1	10	330	10000	(20)
50. 2,4-Dichlorophenol	120-83-2	10	330	10000	(20)
51. 1,2,4-Trichlorobenzene	120-82-1	10	330	10000	(20)
52. Naphthalene	91-20-3	10	330	10000	(20)
53. 4-Chloroaniline	106-47-8	10	330	10000	(20)
54. Hexachlorobutadiene	87-68-3	10	330	10000	(20)
55. 4-Chloro-3-methylphenol	59-50-7	10	330	10000	(20)
56. 2-Methylnaphthalene	91-57-6	10	330	10000	(20)
57. Hexachlorocyclopentadiene	77-47-4	10	330	10000	(20)
58. 2,4,6-Trichlorophenol	88-06-2	10	330	10000	(20)
59. 2,4,5-Trichlorophenol	95-95-4	25	800	25000	(50)
60. 2-Chloronaphthalene	91-58-7	10	330	10000	(20)
61. 2-Nitroaniline	88-74-4	25	800	25000	(50)
62. Dimethylphthalate	131-11-3	10	330	10000	(20)
63. Acenaphthylene	208-96-8	10	330	10000	(20)
64. 2,6-Dinitrotoluene	606-20-2	10	330	10000	(20)
65. 3-Nitroaniline	99-09-2	25	800	25000	(50)
66. Acenaphthene	83-32-9	10	330	10000	(20)
67. 2,4-Dinitrophenol	51-28-5	25	800	25000	(50)
68. 4-Nitrophenol	100-02-7	25	800	25000	(50)

* Previously known by the name bis(2-Chloroisopropyl) ether

Semi-volatiles	CAS Number	Quantitation Limits*			
		Water ug/L	Low Soil ug/Kg	Med. Soil ug/Kg	On Column (ng)
69. Dibenzofuran	132-64-9	10	330	10000	(20)
70. 2,4-Dinitrotoluene	121-14-2	10	330	10000	(20)
71. Diethylphthalate	84-66-2	10	330	10000	(20)
72. 4-Chlorophenyl-phenyl ether	7005-72-3	10	330	10000	(20)
73. Fluorene	86-73-7	10	330	10000	(20)
74. 4-Nitroaniline	100-01-6	25	800	25000	(50)
75. 4,6-Dinitro-2-methylphenol	534-52-1	25	800	25000	(50)
76. N-nitrosodiphenylamine	86-30-6	10	330	10000	(20)
77. 4-Bromophenyl-phenylether	101-55-3	10	330	10000	(20)
78. Hexachlorobenzene	118-74-1	10	330	10000	(20)
79. Pentachlorophenol	87-86-5	25	800	25000	(50)
80. Phenanthrene	85-01-8	10	330	10000	(20)
81. Anthracene	120-12-7	10	330	10000	(20)
82. Carbazole	86-74-8	10	330	10000	(20)
83. Di-n-butylphthalate	84-74-2	10	330	10000	(20)
84. Fluoranthene	206-44-0	10	330	10000	(20)
85. Pyrene	129-00-0	10	330	10000	(20)
86. Butylbenzylphthalate	85-68-7	10	330	10000	(20)
87. 3,3'-Dichlorobenzidine	91-94-1	10	330	10000	(20)
88. Benzo(a)anthracene	56-55-3	10	330	10000	(20)
89. Chrysene	218-01-9	10	330	10000	(20)
90. bis(2-Ethylhexyl)phthalate	117-81-7	10	330	10000	(20)
91. Di-n-octylphthalate	117-84-0	10	330	10000	(20)
92. Benzo(b)fluoranthene	205-99-2	10	330	10000	(20)
93. Benzo(k)fluoranthene	207-08-9	10	330	10000	(20)
94. Benzo(a)pyrene	50-32-8	10	330	10000	(20)
95. Indeno(1,2,3-cd)pyrene	193-39-5	10	330	10000	(20)
96. Dibenz(a,h)anthracene	53-70-3	10	330	10000	(20)
97. Benzo(g,h,i)perylene	191-24-2	10	330	10000	(20)

* Quantitation limits listed for soil/sediment are based on wet weight. The quantitation limits calculated by the laboratory for soil/sediment, calculated on dry weight basis as required by the contract, will be higher.

SEMIVOLATILES

Water Samples

A 1 L volume of water is extracted in a continuous liquid-liquid extractor with methylene chloride at a pH of approximately 2. This extract is reduced in volume to 1.0 mL, and a 2 μ L volume is injected onto the GC/MS for analysis. For a sample with compound X at the CRQL of 10 μ g/L:

(10 μ g/L) (1 L) = 10 μ g in the original extract

When the extract is concentrated, this material is contained in the 1 mL concentrated extract, of which 2 μ L are injected into the instrument:

(10 μ g/mL) (2 μ L) (10^{-3} mL/ μ L) = 20×10^{-3} μ g = 20 ng on the GC column

Low Soil Samples

A 30 g soil sample is extracted three times with methylene chloride/acetone at ambient pH, by sonication. The extract is reduced in volume to 1.0 mL, and a 2 μ L volume is injected onto the GC/MS for analysis. For a sample with compound X at the CRQL of 330 μ g/Kg:

(330 μ g/Kg) (30 g) (10^{-3} Kg/g) = 9900×10^{-3} μ g = 9.9 μ g

When the sample extract is to be subjected to Gel Permeation Chromatography (required) to remove high molecular weight interferences, the volume of the extract is initially reduced to 10 mL. This 10 mL is put through the GPC column, and only 5 mL are collected off the GPC. That 5 mL volume is reduced to 0.5 mL prior to analysis. Therefore:

(9.9 μ g/10 mL) (5 mL) = 4.95 μ g

This material is contained in the 0.5 mL extract, of which 2 μ L are injected into the instrument:

(4.95 μ g/0.5 mL) (2 μ L) (10^{-3} mL/ μ L) = 1.98×10^{-2} μ g) 20 ng on the GC column

Medium Soil Samples

A 1 g soil sample is extracted once with 10 mL of methylene chloride/acetone, which is filtered through glass wool to remove particles of soil. The filtered extract is then subjected to GPC clean up, and only 5 mL of extract are collected after GPC. This extract is reduced in volume to 0.5 mL, of which 2 μ L are injected onto the GC/MS. For a sample with compound X at the CRQL of 10,000 μ g/Kg:

(10,000 μ g/Kg) (1g) (10^{-3} Kg/g) = 10 μ g

(continued)

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Semivolatiles, Medium Soil, continued -

This material is contained in the 10 mL extract, of which only 5 mL are collected after GPC:

(10 ug) (5 mL/10mL) = 5 ug

The volume of this extract is reduced to 0.5 mL, of which 2 mL are injected into the instrument:

(5 ug/0.5 mL) (2 mL) (10⁻³ mL/ μ L) = 20 \times 10⁻³ ug = 20 ng on the GC column

Eight semivolatile compounds are calibrated using only a four point initial calibration, with the lowest standard at 50 ng. Therefore, the CRQL values for these eight compounds are 2.5 times higher for all matrices and levels.